regularly recurrent stable forms which constitute a species. We are inclined to think that this idea, extended to the study of multicellular forms, would show that many so-called species are based on transient "modificational" ephemeromorphs.

There is a dignified candour in Dr. Bastian's attitude towards sceptics. "It will doubtless be said that the facts I have brought forward are mere figments of my imagination, seeing that others observe no such phenomena, and that my experience is altogether exceptional." To this he answers (1) that many recorded phenomena, referred without proof to infection by parasites, are more simply interpretable as heterogenetic; (2) that he has seen the numerous cases he has recorded because he has diligently looked for them through many years; and (3) that, after all, his photographs of transformations have to be explained somehow. We must confess that the photographs, "engraved and printed," appear to us no more than a plethora of puzzles and futilities of delineation. The method is obviously admirable in being impersonal, but it seems to us quite ineffective in showing the transformation of the rotifer's or tardigrade's ova into infusorians. But we can only state our own impression; others may see more in them than we can detect; perhaps the eye of faith will see much.

"Some of my critics have refused to give any adequate consideration to the work because it has not been entirely done under certain impossible conditions which they would prescribe." Dr. Bastian admits that he has not uniformly isolated the organisms under process of change or placed them in a sterilised medium. Such cataclysmal interference would inevitably stop the heterogenetic progress. He declares, however, that the observations in proof of the heterogenetic origin of bacteria and their allies "have been conducted with all necessary precautions against the possibility of infection." If so, and every experimenter will agree that it is a big "if," then the bacteria did arise by heterogenesis, *or* they were present, though unseen, from the first. To the critic who asks why Dr. Bastian did not continuously watch the alleged heterogenetic changes from start to finish on the same individual organism, it is answered that the method pursued was that usually followed in embryological research—that of observing different states of change in different individuals. The method is comparable to that of palæontologists in working out a presumed series of phyletic change; it is not absolutely demonstrative, but it reveals phenomena which must be interpreted somehow; and the best and most reasonable interpretation, "as much as possible irrespective of preconceptions and *a priori* views," seems to the author that of heterogenesis. If it be urged that Dr. Bastian should have watched the heterogenetic processes he believes in with the same sort of assiduous continuity as Dallinger and Drysdale achieved in studying their plastic monads, it is answered that "compliance with such demands would not only be fruitless but would go far to render for ever impossible any knowledge of heterogenesis." Why this should be so we do not understand, unless heterogenesis be like the building of the fairies' palace which always stopped if anyone looked at it. But the fact is that "the methods employed by those who would gain a knowledge of heterogenesis cannot, from the very nature of the subject, be strict laboratory methods"—and this, we fear, will foreclose the question in the eyes of most biologists.

For our part, the suggestion of foreclosing a question like this savours of prejudice, and it should be remembered that results of great value, both theoretically and practically, have issued from the long drawn out controversy over spontaneous generation. After a careful study of Dr. Bastian's book, we venture to sum up our impressions as follows:—(1) If the idea of heterogenesis means, when generalised, that there may be marked discontinuity, or transilience, or *per saltum* change in the ceaseless process of organic variation, then we side with the author, and in this regard he will find that he has many allies. (2) In so far as the idea of heterogenesis implies that many of the lowest forms of life are very plastic creatures of circumstance, capable of passing from phase to phase of the cell-cycle under modificational stimulus, so markedly that they may be called "ephemeromorphs," we again side with the author, for we think that there are many facts which point in this direction. (3) As to the thesis that simple organisms "are ever seething up anew by processes of heterogenesis," it seems to us, in our ignorance, a quite legitimate conception which may eventually be demonstrated as true. (4) But as to the majority of the cases of heterogenesis which Dr. Bastian adduces, we cannot but reject them as inconclusive, not only because the methods employed seem to us to be fallacious, especially in depreciating the possibilities of latent germs and of infection; not only because they lead us to conclusions which we cannot harmonise with our confessedly incomplete biological system; but especially because they are so *meaningless*. If the egg of the Hydatina can, "under conditions not always easy to realise," be transformed into a large ciliated infusorian, then our *Systema Naturae* is a farce.

J. A. T.

PROF. OSTWALD'S JUBILEE.

Jubelband—Wilhelm Ostwald. Gewidmet zur Feier seiner vor fünfundzwanzig Jahren erfolgter Doktorpromotion von seinen Schülern, mit einer Einleitung von J. H. van 't Hoff. Pp. xxxi+679. (*Zeitschrift für physikalische Chemie,* Band 46.)

THIS stately volume is a fitting tribute to an eminent man who has done much to advance the progress of modern chemistry. The triumvirate, van 't Hoff, Arrhenius and Ostwald, the Dutchman, the Swede and the Russo-German, had a hard battle before their doctrines were accepted by physicists and by chemists. The communications made in the first volume of Ostwald's *Zeitschrift* by van 't Hoff (p. 481) on the *rôle* of osmotic pressure in the analogy between liquids

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and gases, and by Arrhenius (p. 631) on the dissociation of substances dissolved in water, brought together the three friends in a manner which we now recognise as almost dramatic. Of Ostwald's 147 pupils, 34 of whom are now professors in universities all over the world, 34 have contributed memoirs to the "Jubelband" in honour of their teacher.

It would be impossible in the limited space of this notice to give an account of the contents of these articles, and it would be invidious to select names and tedious to mention all. Suffice it to say that the memoirs are in French, English and German; that their authors write from Germany, Russia, Finland, Sweden, Austria, Belgium, Greece, England, Scotland and Ireland; and that they are often under two names, implying that a third generation has aided in the research. The subjects of the memoirs range over a wide field; papers relating to solubility, to electric discharge, to electric conductivity, to vapour-pressures, to crystallisation, to catalysis, to capillarity, to high temperature reactions, to stereochemistry, to phase-rule phenomena, to colloids, to critical phenomena, to polarisation phenomena, all are found in this volume, and it is certain that each and all of the authors would acknowledge that their inspiration was derived in great part from their master, Ostwald.

A list is given of Ostwald's publications. The colossal labour of collecting and coordinating all known facts bearing on general chemistry is shown by the fact that the "Lehrbuch der allgemeinen Chemie," begun in 1885 and ended in 1887, required a new edition in 1891, which, indeed, is not yet quite complete; that, in addition to this *magnum opus,* a "Grundriss" was published in 1889; that volumes on "Physicochemical Measurements" (1893), "The Scientific Foundations of Analytical Chemistry" (1894), "Electrochemistry" (1896), "Outlines of Inorganic Chemistry" (1900), "Lectures on Philosophy" (1902) and "Chemical Dialogues" ("Die Schule der Chemie") (1903) have all proceeded from Ostwald's facile pen; and that translations of many of these works have appeared in English, Russian, French, Polish, Czech and Japanese. Besides these original works Ostwald has edited and annotated since 1889 selections from the works of Dalton, Wollaston, Gay-Lussac, Avogadro and Ampère, Hess, Hittorf, Wilhelmy, Bunsen and Roscoe, Berzelius, Carnot, Dulong and Petit, Davy, Scheele, Kirchhoff and Bunsen, and Berthollet, in the series of "Classics of Exact Science"; he has edited, along with van 't Hoff, the *Zeitschrift für physikalische Chemie* since 1887, of which 45 volumes have now appeared (it is to be presumed that the editorship of this, the forty-sixth, was not carried out by him); and since 1875 he has published no fewer than 120 papers and memoirs, embodying in large measure the results of his own researches; lastly, he has contributed about 3880 abstracts of papers and 890 reviews of books to the Zeitschrift which goes by his name.

One may well ask, how was it done? Those who know Ostwald will still be amazed; but they will recall to their minds that he possesses a rapidity of thought, an extraordinarily retentive memory, an astounding diligence and a pen which moves without effort; and perhaps most important of all, the power of expressing his ideas and those of others in clear language. Indeed, it may almost be said that Ostwald has imparted to German the accuracy and lucidity of French.

The volume contains an excellent portrait of Ostwald at his desk, and van 't Hoff prefaces the contents by a short biography, from which we learn that he was born in 1853 in Riga, that he was there as schoolboy, student, assistant, "privat-docent" and professor, until, in 1887, he was called to fill the chair of physical chemistry in Leipzig, a position which he still holds. Van 't Hoff also sketches Ostwald as a teacher, an investigator, an organiser and a reformer, and traces his progress in research from his earliest work on "The Mass-action of Water" to his latest work on the "Philosophy of Nature." The gap may appear a wide one, where only the two ends of the curve are given; but it is a continuous curve, and one which abundantly testifies to the "Stetigkeit," or continuity, of natural phenomena. Ostwald's missionary zeal is also pourtrayed.

> "He is not content in gaining a view for himself; it is perhaps with him a necessity to impregnate others with his thoughts, and this has doubtless largely contributed to the present-day position of physical chemistry. The spreading of his ideas abroad runs parallel with his own activity in research and original thought."

Again :—

> "In Ostwald as organiser we admire the practical man, who sees clearly what can be done, in small as well as in great things. On the small scale he is the constructor and deviser of handy apparatus, which he himself enjoys making, and the contriver of convenient methods of work. . . . On the large scale, he carries this sense of the practical to the erection of a pattern laboratory in the new institute at Leipzig, dedicated chiefly to physical chemistry, and embodying the many-sided mind of the master."

And in picturing another side of Ostwald's character, van 't Hoff writes regarding the work of Arrhenius (and though modesty forbids him to mention it, of himself) :—

> "How often do we see in similar cases an estrangement! With Ostwald, however, the opposite; sympathetic cooperation, in which Nernst soon joined as a partner."

Lastly, in dealing with Ostwald's many-sidedness, for example, in founding the Bunsen Society for Electrochemistry and editing the *Annalen der Naturphilosophie* :—

> "The astonishing thing, when we consider Ostwald's activity, ever extending to wider and wider circles, is that neither his interest in his former sphere of work nor his mastery over it lessens."

Fortunate they who have been Ostwald's students; and happy they who possess his friendship!

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